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30th Annual AMS Survey 1986

First Report

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30th Annual AMS Survey 1986

First Report

The following pages contain a first report on the 1986 AMS Survey. Included in this report are salary and other data on faculty members in four-year colleges and universities, a report on the 1986 survey of new doctorates, a report on salaries of new doctorates, and a list of names and thesis titles for members of the 1985-1986 Ph.D. class.

The Annual AMS Survey is conducted in two parts. Questionnaires were distributed in May to departments in the mathematical sciences in colleges and universities in the United States and Canada, and later to the recipients of doctoral degrees granted by these departments between July 1985 and June 1986, inclusive. This report is based on the information collected from these questionnaires. A second round of questionnaires was distributed in September; these are concerned with data on fall enrollments, class size, teaching loads, and faculty mobility, and new this year, retirement trends and extramural support. These data will be reported in the February 1987 issue of *Notices*.

This Survey is the thirtieth in an annual series begun in 1957 by the Society's Committee on the Economic Status of Teachers. The present Survey is under the direction of the Committee on Employment and Educational Policy (CEEP), whose members are Stefan A. Burr, Edward A. Connors, Philip C. Curtis, Jr., Gerald J. Janusz, Donald C. Rung (chairman), and Audrey A. Terras. The questionnaires were devised by CEEP's Data Subcommittee consisting of Lida K. Barrett, Edward A. Connors (chairman), Lincoln K. Durst, James Hurley, Charlotte Lin, James W. Maxwell, Donald E. McClure, and Donald C. Rung.

Faculty Salaries, Tenure, Women

The questionnaires sent to departments in the mathematical sciences asked for information on salaries and tenure. Departments submitted a minimum, median, and maximum salary figure for each of four academic ranks, for staff members both with and without doctorates. Annual salaries of full-time faculty members for the academic year of 9 or 10 months were sought. The 1986 questionnaire requested information for both the years 1985-1986 and 1986-1987. The sample in this survey is thus the same for both years and is different from the sample used in the Twenty-Ninth AMS Survey in 1985. In the salary tables on the following pages the numbers in parentheses give the range of the middle fifty percent of salaries reported. The figures outside the parentheses represent the minimum and maximum salary listed by any reporting institution. In some categories relatively few departments reported and, because significant figures were not available, salaries are not listed.

The information reported this year on the number of faculty members is based on returns from 635 departments in the mathematical sciences, 48 of which did not contain usable salary information.

For these reports, the departments are divided into groups according to the highest degree offered in the mathematical sciences. The doctorate-granting departments are in six groups as described in the box.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0 – 5.0 range.

Group II is composed of 43 departments with scores in the 2.0 – 2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257 – 267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392 – 393.

Table 1: Total Faculty Reported for Four-Year Colleges and Universities

	1985–1986				1986–1987			
	Faculty		Women		Faculty		Women	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
WITHOUT DOCTORATE								
Instructor/Lecturer	914	47	510	22	807	45	427	20
Assistant Professor	552	299	166	78	548	277	167	74
Associate Professor	373	347	49	44	358	320	51	41
Professor	111	106	15	9	105	96	13	10
Total	1950	799	740	153	1818	738	658	145
WITH DOCTORATE								
Instructor/Lecturer	264	35	48	3	262	35	56	5
Assistant Professor	1845	205	316	35	1869	206	330	31
Associate Professor	2497	2145	236	196	2510	2113	239	203
Professor	4070	3997	200	189	4093	4004	206	195
Total	8676	6382	800	423	8734	6358	831	434

TABLE 2: Percent of Doctorate Faculty with Tenure

	Fall 1985	Fall 1986
Groups I, II, III	76.8%	76.6%
Groups IV, V	71.4%	71.8%
Group VI	88.5%	86.6%
Masters and Bachelors	68.4%	66.8%

TABLE 3: Response Rates

U.S. Departments

Group	I	II	III	IV	V	M	B
% Response	77	67	67	62	46	47	34

Canadian Departments

Group	VI
% Response	61

Response Rates. Response rates among the various classes of departments vary widely, thus making it difficult to draw firm conclusions about the sizes of the faculty groups studied. Because the questionnaires request data for two years in a row, however, it is possible to estimate relative changes from one year to the next with somewhat more confidence. This year's response rates are given in Table 3. As in past years, the greatest rates of response are in Groups I, II, and III, which have a combined response rate of 70%.

	SIZE OF FACULTY								SALARIES (*in hundreds of dollars*)					
	1985–1986				1986–1987				1985–1986			1986–1987		
	FACULTY		WOMEN		FACULTY		WOMEN							
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure	Minimum	Median	Maximum	Minimum	Median	Maximum
DOCTORATE GRANTING DEPARTMENTS, Group I					(30 of 39 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	16	3	10	2	17	3	10	2						
Assistant Professor	2	2	1	1	2	2	1	1						
Associate Professor	2	2	0	0	2	2	0	0						
Professor	1	1	0	0	1	1	0	0						
	21	8	11	3	22	8	11	3						
WITH DOCTORATE														
Instructor/Lecturer	99	0	9	0	99	0	13	0	201(223-256)	(230-258)	(238-268)270	207(238-270)	(241-271)	(241-280)285
Assistant Professor	200	4	19	2	200	4	21	0	217(250-272)	(256-297)	(285-323)366	229(262-294)	(280-320)	(311-354)391
Associate Professor	237	225	16	15	246	234	16	16	249(293-333)	(334-359)	(354-436)540	268(298-351)	(355-399)	(393-464)568
Professor	887	887	28	28	902	902	29	29	262(337-419)	(450-514)	(638-780)896	303(347-431)	(448-543)	(701-850)910
	1423	1116	72	45	1447	1140	79	45						
DOCTORATE GRANTING DEPARTMENTS, Group II					(29 of 43 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	47	4	33	2	45	3	31	2	141(165-226)	(169-231)	(168-247)259	172(174-208)	(175-232)	(175-260)270
Assistant Professor	7	7	1	1	7	7	1	1	—	—	—	—	—	—
Associate Professor	11	10	4	3	11	10	4	3	—	—	—	—	—	—
Professor	4	4	0	0	3	3	0	0	—	—	—	—	—	—
	69	25	38	6	66	23	36	6						
WITH DOCTORATE														
Instructor/Lecturer	34	0	8	0	37	0	10	0	150(165-210)	(181-219)	(183-223)260	180(180-236)	(193-237)	(203-248)270
Assistant Professor	209	13	32	2	203	24	29	2	198(230-255)	(258-292)	(273-336)427	266(251-290)	(270-318)	(290-356)448
Associate Professor	310	290	18	17	319	290	18	16	241(272-310)	(303-352)	(354-402)492	257(281-330)	(313-382)	(364-433)527
Professor	541	538	17	17	549	545	20	20	288(320-379)	(399-471)	(577-712)792	319(333-404)	(424-519)	(583-758)848
	1094	841	75	36	1108	859	77	38						
DOCTORATE GRANTING DEPARTMENTS, Group III					(49 of 73 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	93	3	61	3	83	1	54	1	120(150-210)	(160-211)	(174-232)318	120(160-222)	(170-226)	(182-249)340
Assistant Professor	40	27	16	9	41	28	17	10	170(222-284)	(231-284)	(242-291)427	177(228-284)	(246-292)	(256-295)427
Associate Professor	20	18	1	1	20	18	1	1	270(277-364)	(284-368)	(294-383)408	240(282-378)	(288-379)	(309-409)441
Professor	11	11	6	0	9	9	0	0	—	—	—	—	—	—
	164	59	84	13	153	56	72	12						
WITH DOCTORATE														
Instructor/Lecturer	57	25	9	1	53	25	9	2	180(195-251)	(193-258)	(230-285)625	120(180-283)	(193-299)	(200-306)660
Assistant Professor	286	41	41	5	323	44	49	5	170(232-265)	(252-282)	(260-320)385	177(240-277)	(267-300)	(292-341)420
Associate Professor	394	350	24	23	383	342	26	24	185(267-306)	(305-351)	(334-409)533	187(271-330)	(310-372)	(349-439)568
Professor	587	578	16	16	593	584	17	17	290(324-390)	(394-453)	(503-616)850	305(340-421)	(409-483)	(532-662)898
	1324	994	90	45	1352	995	101	48						

DOCTORATE GRANTING DEPARTMENTS, Group IV					(43 of 69 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	9	1	4	0	8	1	4	0						
Assistant Professor	5	2	0	0	3	2	0	0						
Associate Professor	1	1	0	0	1	1	0	0						
Professor	5	3	0	0	5	3	0	0						
	20	7	4	0	17	7	4	0						
WITH DOCTORATE														
Instructor/Lecturer	7	1	5	1	5	1	3	1	—	—	—	—	—	—
Assistant Professor	152	5	26	0	142	3	29	0	205(249-280)	(276-308)	(280-329)390	220(256-300)	(282-319)	(293-352)4?2
Associate Professor	135	113	13	9	147	127	14	12	241(290-341)	(323-382)	(341-401)481	272(312-368)	(347-393)	(355-441)510
Professor	322	308	14	12	325	310	13	11	301(365-444)	(453-566)	(538-717)892	324(390-480)	(473-609)	(569-804)948
	616	427	58	22	619	441	59	24						
DOCTORATE GRANTING DEPARTMENTS, Group V					(13 of 28 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	0	0	0	0	0	0	0	0						
Assistant Professor	0	0	0	0	0	0	0	0						
Associate Professor	1	1	0	0	0	0	0	0						
Professor	2	2	0	0	2	2	0	0						
	3	3	0	0	2	2	0	0						
WITH DOCTORATE														
Instructor/Lecturer	6	0	1	0	6	0	1	0	—	—	—	—	—	—
Assistant Professor	34	8	3	0	32	8	2	0	260(265-321)	(293-357)	(314-397)422	272(286-383)	(304-405)	(323-455)473
Associate Professor	30	26	2	1	21	18	1	0	296(343-441)	(366-443)	(372-478)545	302(366-468)	(381-495)	(385-558)617
Professor	101	101	3	3	86	82	3	3	230(356-492)	(500-551)	(633-743)800	339(405-520)	(515-597)	(700-850)880
	171	135	9	4	145	108	7	3						
DOCTORATE GRANTING DEPARTMENTS, Group VI (Canadian Departments)					(17 of 28 reporting)									
WITHOUT DOCTORATE														
Instructor/Lecturer	11	1	6	1	9	1	6	1						
Assistant Professor	19	13	5	5	20	14	5	5						
Associate Professor	13	13	2	2	13	13	2	2						
Professor	7	7	0	0	7	7	0	0						
	50	34	13	8	49	35	13	8						
WITH DOCTORATE														
Instructor/Lecturer	2	0	1	0	2	0	2	0	—	—	—	—	—	—
Assistant Professor	61	13	9	4	67	13	10	3	218(220-273)	(255-304)	(279-345)452	220(233-278)	(272-290)	(286-360)470
Associate Professor	183	176	10	9	180	169	11	10	274(304-385)	(351-430)	(397-520)624	280(309-374)	(374-432)	(398-516)649
Professor	252	252	6	6	253	253	6	6	352(365-451)	(443-532)	(503-706)820	333(366-439)	(450-515)	(497-703)782
	498	441	26	19	502	435	29	19						

SIZE OF FACULTY

	1985–1986				1986–1987			
	FACULTY		WOMEN		FACULTY		WOMEN	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
MASTER DEGREE GRANTING DEPARTMENTS (128 of 272 reporting)								
WITHOUT DOCTORATE								
Instructor/Lecturer	377	28	226	12	326	28	187	11
Assistant Professor	194	135	52	26	178	118	47	22
Associate Professor	142	138	18	18	136	127	17	15
Professor	49	48	5	5	42	39	6	5
	762	349	301	61	682	312	257	53
WITH DOCTORATE								
Instructor/Lecturer	46	5	11	1	48	6	15	2
Assistant Professor	493	74	80	12	503	70	91	13
Associate Professor	673	565	86	75	652	538	84	71
Professor	857	841	59	58	862	837	63	62
	2069	1485	236	146	2065	1451	253	148
BACHELOR DEGREE GRANTING DEPARTMENTS (326 of 950 reporting)								
WITHOUT DOCTORATE								
Instructor/Lecturer	361	7	170	2	319	8	135	3
Assistant Professor	285	113	91	36	297	106	96	35
Associate Professor	183	164	24	20	175	149	27	20
Professor	32	30	4	4	36	32	7	5
	861	314	289	62	827	295	265	63
WITH DOCTORATE								
Instructor/Lecturer	13	4	4	0	12	3	3	0
Assistant Professor	410	47	106	10	399	40	99	8
Associate Professor	535	400	67	47	562	395	69	54
Professor	523	492	57	49	523	491	55	47
	1481	943	234	106	1496	929	226	109

SALARIES
(in hundreds of dollars)

	1985–1986			1986–1987		
	Minimum	Median	Maximum	Minimum	Median	Maximum
WITHOUT DOCTORATE						
Instructor/Lecturer	123(170-200)	(178-217)	(194-242)495	130(175-209)	(186-234)	(199-252)530
Assistant Professor	139(225-290)	(241-303)	(255-316)391	147(236-298)	(254-313)	(266-332)412
Associate Professor	161(278-334)	(295-351)	(313-365)499	170(290-348)	(312-368)	(318-386)499
Professor	194(309-395)	(318-395)	(329-431)526	208(347-435)	(344-439)	(356-449)487
WITH DOCTORATE						
Instructor/Lecturer	153(203-290)	(209-300)	(221-306)335	162(182-318)	(213-294)	(221-322)353
Assistant Professor	161(230-265)	(245-281)	(261-320)450	169(237-275)	(255-295)	(275-334)480
Associate Professor	187(267-308)	(293-347)	(318-390)460	196(282-321)	(308-357)	(340-407)484
Professor	222(324-380)	(365-426)	(394-487)700	233(340-400)	(373-447)	(424-519)750
WITHOUT DOCTORATE						
Instructor/Lecturer	113(171-205)	(176-208)	(184-220)288	144(185-220)	(185-228)	(198-237)355
Assistant Professor	141(201-250)	(209-260)	(220-287)374	152(209-261)	(218-270)	(230-291)394
Associate Professor	185(248-322)	(244-316)	(255-336)445	170(259-335)	(255-340)	(265-341)427
Professor	237(272-374)	(293-384)	(293-384)457	240(272-383)	(317-404)	(307-408)479
WITH DOCTORATE						
Instructor/Lecturer	175(188-221)	(202-250)	(211-271)279	200(200-237)	(200-270)	(217-290)293
Assistant Professor	177(218-249)	(230-262)	(238-291)430	170(236-261)	(247-280)	(250-302)465
Associate Professor	199(254-304)	(262-321)	(283-354)482	199(270-315)	(277-335)	(299-361)525
Professor	195(294-385)	(308-398)	(329-437)601	201(314-399)	(323-414)	(344-451)720

Salary Survey for New Recipients of Doctorates

The figures for 1986 in this article were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1985-1986 academic year from universities in the United States and Canada.

Questionnaires requesting information on salaries and professional experience were distributed to 676 recipients of degrees using addresses provided by the departments which granted the degrees. Of these, 9 were returned by the postal service as undeliverable and could not be forwarded. There were 303 individuals who returned forms between late June and early September. The tables below are based on the responses from 270 of these individuals (227 men and 43 women). Data from 33 responses were not used in the compilation of the tables below; forms with insufficient data, or from individuals who had indicated they had part-time employment, were not yet employed, or were not seeking employment were considered unusable.

Readers should be warned that the data in this report are obtained from a self-selected sample and inferences from them may not be representative of the population. More comprehensive information on the number, the sex—minority group status—citizenship, and the employment status of the recipients of new doctorates granted last year in the mathematical sciences in the U.S. and Canada may be found in the previous article of this report on the 1986 Survey.

Key to Tables. *Salaries* are listed in hundreds of dollars. *Years* listed refer to the academic year ending in the listed year. *M* and *F* are Male and Female respectively. *One year experience* means that the persons had experience limited to one year or less in the same position or a position similar to the one reported; some persons receiving a doctorate had been employed in their present position for several years. $(X + Y)$ means there are *X men and Y women* in the 1986 sample. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

Graphs. For each category and year, the median starting salary is denoted by a horizontal bar; a vertical bar extends to the extremes. The salary information in the graphs is in hundreds of dollars.

The connected line segments equate value of the dollar from one year to the next, using the 1965 median starting salary as a benchmark and adjusting that to current dollars by the implicit price deflators prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. Because the deflator is not yet available for this year, the 1986 figures do not appear on the graphs. If the rate of change in the actual starting salaries is less than the slope of the corresponding line segment, median starting salaries did not keep up with inflation.

Note that starting salaries for all categories fall behind the cost of living change in 1975 as compared to 1970. Some of this loss was made up between 1980 and 1982. (For a more detailed analysis of academic salaries, see Donald Rung's article, "A Fifteen Year Retrospective on Academic Salaries of U.S. Doctorate Holding Faculty," in the November 1985 issue of *Notices*, pp. 772-773.) "Between 1984 and 1985, in academe and in business, median starting salaries gained only slightly with respect to inflation, whereas for twelve-month research positions, they gained substantially." However, starting salaries in government lost ground to inflation from 1984 to 1985.

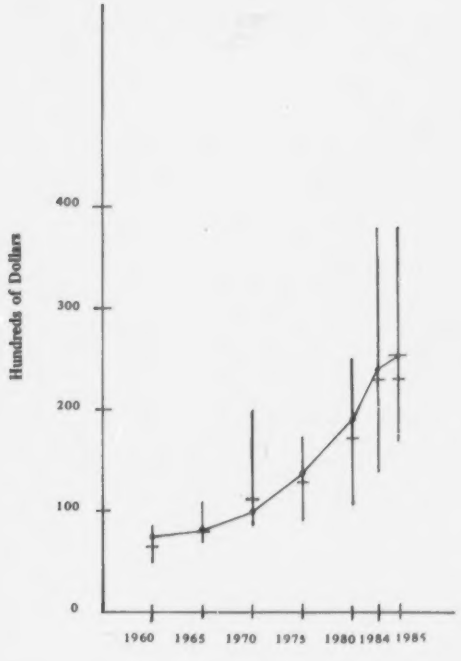
Nine-Month Salaries

Year	Min	Q_1	Median	Q_3	Max	1965 Salary Median in Current $
TEACHING OR TEACHING AND RESEARCH (128 + 28)						
1960	49		65		80	74
1965	70		80		105	80
1970	85		110		195	98
1975	90	120	128	135	173	135
1980	105	155	171	185	250	192
1981	130	175	190	210	320	210
1982	160	190	206	229	370	223
1983	80	200	217	240	350	232
1984	140	215	230	255	380	241
1985	170	23	250	270	380	249
1986	170	250	269	290	400	—
1983M	95	204	220	240	350	
1983F	80	198	210	227	330	
1984M	140	215	232	255	380	
1984F	161	215	228	251	325	
1985M	186	232	250	270	380	
1985F	170	215	242	270	366	
1986M	170	250	269	290	400	
1986F	230	250	268	294	270	
One Year Experience (108 + 21)						
1986M	170	250	270	291	400	
1986F	230	250	270	290	370	

Nine-Month Salaries

Year	Min	Median	Max	1965 Salary Median in Current $
RESEARCH (5 + 1)				
1960	52	65	80	75
1965	71	81	90	81
1970	78	105	160	100
1975	100	—	110	137
1980	125	137	180	195
1981	143	—	145	213
1982	180	190	235	226
1983	100	200	230	235
1984	205	205	205	244
1985	205	235	250	252
1986	215	245	280	—
1983M	100	200	230	
1983F	205	205	205	
1984M	205	205	205	
1984F	—	—	—	
1985M	205	226	250	
1985F	—	—	—	
1986M	215	250	280	
1986F	240	240	240	
One Year Experience (5 + 1)				
1986M	215	250	280	
1986F	240	240	240	

Nine-Month Teaching



Graph omitted because sample size too small

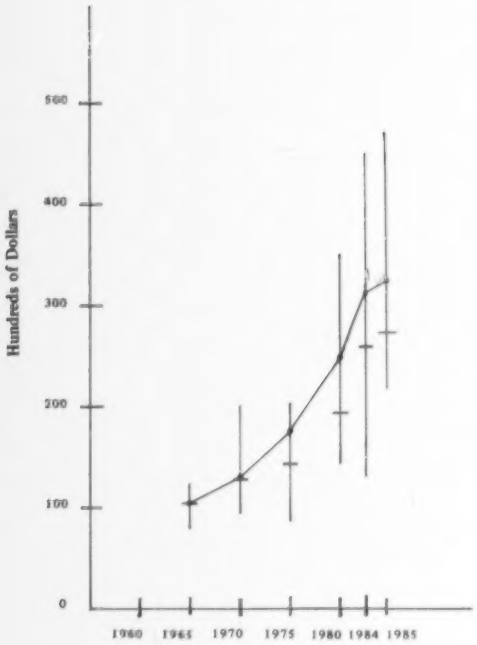
Twelve-Month Salaries

Year	Min	Median	Max	1965 Salary Median in Current $
TEACHING OR TEACHING AND RESEARCH (30 + 4)				
1960	..... NO DATA			
1965	78	104	121	104
1970	95	128	200	128
1975	87	145	204	176
1980	143	195	350	250
1981	156	203	400	274
1982	100	250	500	290
1983	160	260	320	301
1984	134	260	450	313
1985	220	273	470	323
1986	220	320	480	—
1983M	160	255	320	
1983F	240	265	270	
1984M	134	260	450	
1984F	240	275	330	
1985M	230	240	470	
1985F	220	280	420	
1986M	220	320	480	
1986F	240	285	360	
One Year Experience (23 + 4)				
1986M	220	305	444	
1986F	240	285	360	

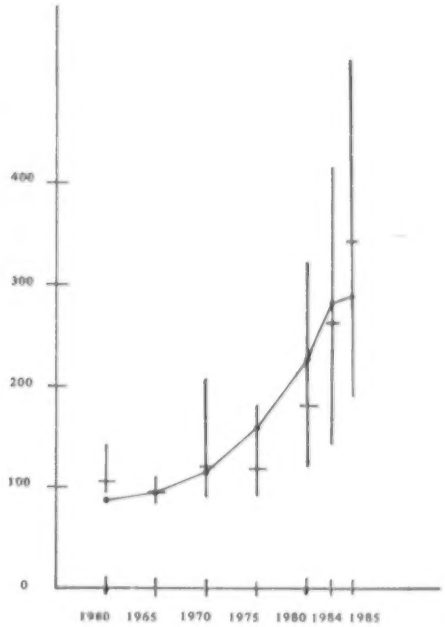
Twelve-Month Salaries

Year	Min	Median	Max	1965 Salary Median in Current $
RESEARCH (22 + 2)				
1960	97	105	140	86
1965	81	93	107	93
1970	90	120	205	114
1975	90	119	180	157
1980	120	180	321	224
1981	140	200	280	245
1982	130	245	364	259
1983	155	262	450	269
1984	145	261	415	280
1985	190	342	520	286
1986	160	300	510	—
1983M	195	262	450	
1983F	155	260	364	
1984M	170	283	415	
1984F	145	200	253	
1985M	190	360	520	
1985F	279	300	323	
1986M	160	300	510	
1986F	240	270	300	
One Year Experience (21 + 2)				
1986M	160	300	480	
1986F	240	—	300	

Twelve-Month Teaching



Twelve-Month Research



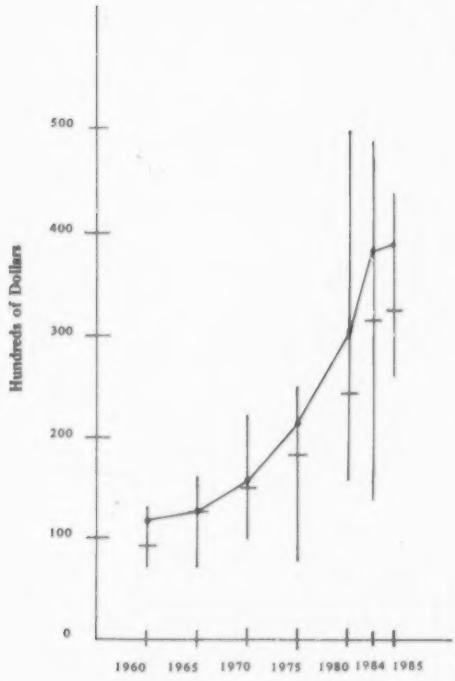
Twelve-Month Salaries

Year	Min	Median	Max	1965 Salary Median in Current $
		GOVERNMENT (10 + 0)		
1960	72	93	130	117
1965	70	126	160	126
1970	100	150	223	155
1975	78	182	247	213
1980	156	244	501	303
1981	220	290	460	332
1982	228	325	470	351
1983	160	322	422	365
1984	140	315	490	379
1985	263	325	440	392
1986	270	400	610	—
1983M	160	313	422	
1983F	293	320	350	
1984M	288	326	490	
1984F	140	202	263	
1985M	263	325	440	
1985F	—	—	—	
1986M	270	400	610	
1986F	—	—	—	
One Year Experience (3 + 0)				
1986M	270	325	330	
1986F	—	—	—	

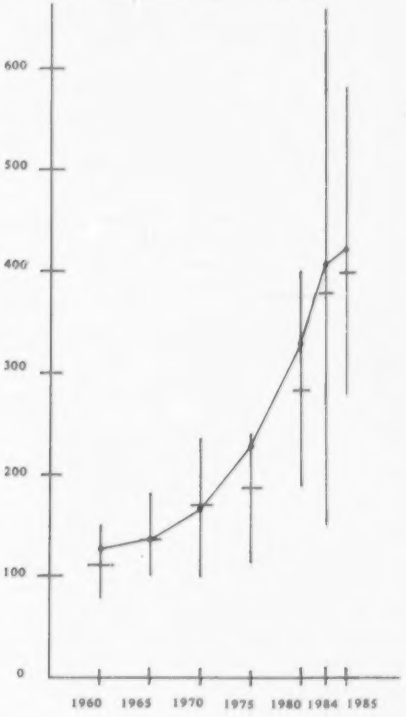
Twelve-Month Salaries

Year	Min	Median	Max	1965 Salary Median in Current $
		BUSINESS AND INDUSTRY (32 + 8)		
1960	78	110	150	126
1965	100	136	180	136
1970	96	170	235	167
1975	114	187	240	230
1980	190	284	400	327
1981	195	308	500	358
1982	196	354	550	379
1983	276	375	580	394
1984	180	378	660	409
1985	260	400	493	423
1986	324	425	750	—
1983M	300	370	580	
1983F	276	375	413	
1984M	180	383	660	
1984F	200	342	416	
1985M	260	400	493	
1985F	295	370	430	
1986M	324	453	750	
1986F	350	375	440	
One Year Experience (21 + 7)				
1986M	324	420	500	
1986F	350	360	440	

Twelve-Month Government



Twelve-Month Business and Industry



Report on the 1986 Survey of New Doctorates

Edward A. Connors

This report presents a statistical profile of new doctorates in mathematical sciences awarded by universities in the United States and Canada during the period July 1, 1985, through June 30, 1986. It includes the employment status of recipients of 1985-1986 doctorates in mathematical sciences (as of August 20, 1986) and an analysis of the data by sex, minority group, and citizenship. In addition, trends in the number of doctoral degrees are reported for each of the Groups I through V (see the first page of this Report of the 1986 Annual AMS Survey for a description of the classification system and *Notices*, June 1983, for a listing of the departments in Groups I and II. Table 0 provides information on the response rates for this part of the Survey.

TABLE 0: Response Rates

Group I	37 of 39
Group II	39 of 43 including 2 with 0 degrees
Group III	65 of 73 including 18 with 0 degrees
Group IV	55 of 69 including 8 with 0 degrees
Group Va	10 of 21 including 2 with 0 degrees
Group Vb	16 of 38 including 3 with 0 degrees
Group VI	24 of 29 including 8 with 0 degrees

We continue the practice adopted in the 1983 Report and do not report doctorates granted by computer science departments (formerly included with the totals for Group V departments). The reporting rate of computer science doctorates was considered too small to merit inclusion. In the 1982 Survey, for example, 105 doctorates in computer science were reported whereas the actual number of degrees granted was more than twice that number. For 1982 the National Science Foundation reported 220 doctorates awarded in computer science (under the heading Mathematical Sciences) and 72 doctorates in Computer Engineering (*Science and Engineering Doctorates: 1960-82*, NSF 83-328, pages 19 and 17 respectively). In contrast, virtually all of the mathematical sciences doctorates are reported. Thus, any year to year comparisons that bridge the 1982 and 1983 Surveys should accommodate this modification. This year we initiate a presentation in Table 1C of the number of doctorates in the mathematical sciences awarded by departments and/or programs in Groups I, II, III, IV, Va, and VI for the years 1982-1983 to 1985-1986. All but the entry for 1985-1986 are the spring counts.

TABLE 1A: New Doctorates, Fall Counts

80-81	81-82	82-83	83-84	84-85	85-86
812	755	792	789	769	801

TABLE 1B: New Doctorates, Fall and Spring Counts

	80-81	81-82	82-83	83-84	84-85	85-86
Fall	904*	860*	792	789	769	801
Spring	927*	914*	840	827	807	**

TABLE 1C: New Doctorates Awarded by Groups I–Va, VI

82-83	83-84	84-85	85-86
767	735	755	717***

* Includes computer science.

** To appear in *Notices*, February 1987.

*** This is a fall count. The other entries in Table 1C are spring counts.

Table 1C will be updated to include a spring count for 1985-1986 in the February *Notices*.

The number of new doctorates reported for 1985-1986 is 801 (fall 1986 count) compared to 769 for 1984-1985 (fall 1985 count). The comparable statistics for 1983-1984 and 1982-1983 are 789 and 792, respectively. None of these tallies include doctorates awarded by computer science departments. These numbers are obtained from the Annual Survey Reports in the November *Notices* and appear as part of Table 1A. In Table 1C we record for the first time a count of new doctorates in the mathematical sciences in the U.S. and Canada for the years 1982-1983 through 1985-1986, exclusive of Group Vb. The response rate for Group Vb is the lowest of all groups, and the responders include departments in engineering and management science.

As is customary, a second, updated report is planned for the February 1987 issue of *Notices*. Table 1B contrasts the number of new doctorates reported in the November Reports with the more complete totals reported in the following spring Reports for the years 1980-1981 to 1984-1985. The last column is the number reported in this Survey. Note that the table entries prior to 1982-1983 include the computer science departments and, thus, this table is comparable to Table 1b from last year's Report (*Notices*, November 1985, page 768).

The data for 1985-1986 shows an increase of 4% in doctorates awarded compared to 1984-1985 and an increase of 3% over the four-year average from the years 1981-1982 through 1984-1985. These percentages are computed from the fall counts of the cited years. However, if we exclude the doctorates reported by the respondents in Group Vb, these increases are no longer present. The second part of this report, to appear in February, will include a similar computation based on spring counts.

Of the 756 doctorates reported from U.S. universities (there were 45 doctorates from Canadian

TABLE 2: Employment Status of 1985-1986 New Doctorates in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS: Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	19	20	22	1	1	4	2		15		4	88
Group II	5	6	7		2	1			10		3	34
Group III	4	9	6	3		7	1	1	10	1	2	44
Group IV					4	28					3	35
Group V		1			1	4	1	4	5		1	17
Masters	10	8	9	3		10	2	2	14		2	60
Bachelors	11	15	7	6	3	5	2	2	7		2	60
Two-year College	1	1						1		1		4
Other Academic Departments		2		1	1	19	2	15	12		12	64
Research Institutes	4	2				3		1	1		1	12
Government	1		1			9		3	6		5	25
Business and Industry	4	7		1	1	32	5	15	18		19	102
Canada, Academic	3	5	2	1		4		1	5		1	22
Canada, Nonacademic	1								2			3
Foreign, Academic	17	19	6	2	4	18		3	14		6	89
Foreign, Nonacademic	2	5	2	2	5	10		7	7		6	46
Not seeking employment	1	1	1			5			1			9
Not yet employed	6	1	8	1	1	6		1	14		4	42
Unknown	10	5	4	2	3	6	1	6	7		1	45
Total	99	107	75	23	26	171	16	62	148	2	72	801

TABLE 3: Sex, Minority Group, and Citizenship of New Doctorates

July 1, 1985–June 30, 1986

U.S. DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander	13		129	1	143	3		31		34	177
Black	2		6		8	3				3	11
American Indian, Eskimo, Aleut								1		1	1
Mexican American, Chicano, Puerto Rican	4		3	1	8	2				2	10
None of those above	271	5	163		439	70		22		92	531
Unknown	14		8		22	4				4	26
Total Number	304	5	309	2	620	82		54		136	756

CANADIAN DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander			10		10						10
Black											
American Indian, Eskimo, Aleut											
Mexican American, Chicano, Puerto Rican											
None of those above		13	12		25	1	2			3	28
Unknown		4		2	6				1	1	7
Total Number		17	22	2	41	1	2		1	4	45

universities), the citizenship is reported as known for 754 recipients, with U.S. citizens accounting for 51% (386). The percentage of U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities has declined consistently and dramatically from 73% in 1979-1980 to 51% in 1985-1986. If we delete Group Vb from consideration, the number of U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities in 1985-1986 is clearly below 400.

Women comprise 21% of the U.S. citizens receiving doctorates in the mathematical sciences from U.S. universities in 1985-1986. Since 1972-1973 this percentage has more than doubled. It had held fairly constant at or above 20% for the last three years. Table 6 presents this data for the period 1972-1973 to 1985-1986.

The employment matrix, Table 2, is similar to last year's, with a few exceptions. There are 35 new doctorates employed by Group IV departments compared to 18 in 1984-1985. There is a decline in the number of new doctorates reporting statistics as a specialty (171, down from 189) and likewise for probability (26, down from 39). However, there is an increase in the number of new doctorates reporting applied mathematics as a specialty (148, up from 115) and likewise for operations research (62, up from 41). Most of the latter increase seems to be a reflection of the increase in doctorates reported by Group Vb in comparison to last year.

Employment Status of New Doctorates, 1985-1986. Table 2 shows the employment status, by type of employer and field of degree, of the 801 recipients of doctoral degrees conferred by the mathematical sciences departments in the U.S. and Canada between July 1, 1985 and June 30, 1986. The names of these 801 individuals are listed with their thesis titles in a later section of this Report.

In rows 1 through 5, the numbers represent those who have accepted appointments in U.S. doctorate-granting mathematical sciences departments (Groups I – V). In the next two rows, the figures represent those accepting appointments in U.S. mathematical sciences departments granting masters and bachelors as the highest degree. The information was obtained from the departments granting the degrees and from the recipients themselves.

Among the 1985-1986 new doctorates employed in the U.S. (545), 62% (338) took academic positions in university or four-year college mathematical sciences departments, and 23% (127) took employment in government, business, or industry. Each of these is one percentage point higher than reported in November of 1984 and 1985.

Table 2 shows as "not yet employed" about 6% of the 1985-1986 new doctorates, excluding those whose employment status is unknown. The data in Table 2 were obtained in many instances early in the summer of 1986 and do not reflect subsequent hiring; an update of Table 2 is planned for the February 1987 *Notices*. A similar update last year revealed that all but 6 new 1984-1985 doctorates found positions by fall 1985 (see *Notices*, November 1985, page 769, and March 1986, page 293). Nine persons included in Table 2 reported taking part-time employment.

Table 2 shows that recipients in the two employment categories *foreign academic* and *foreign nonacademic* comprise a total of 135 or 17% of the 801 new doctorates — corresponding numbers for last year were 140 and 18%, respectively.

Sex, Minority Group, and Citizenship of New Doctorates, 1985-1986. Table 3 presents a breakdown according to sex, minority group, and citizenship of these 801 new doctorates. The information reported in this table was obtained from departments granting the degrees and in some cases from the recipients themselves.

Analyses of the 1985-1986 employment forms of the new doctorates indicate that of the 166 new doctorates employed by Group I, II, or III departments, 16% are women, an increase of 3 percentage points from the 13% reported last year, and an increase of 6 percentage points over the 10% reported in the three prior years.

Of the 120 new doctorates employed by Groups M and B institutions, 21% are women (compared to 26% last year); of the 127 new doctorates employed by government, business, or industry, 14% are women (compared to 15% last year).

Trends in the Number of New Doctorates. Table 4 gives the number of doctorates granted during 1983-1984, 1984-1985, and 1985-1986 by those departments in Groups I – VI *which reported in all three years* (as of August 20, 1986). This is the same criterion used in last year's Report. The number of such departments out of the total is given in parentheses. (Computer science departments are not included.) The entries for the 1983-1984 and 1984-1985 columns should *not* be expected to agree with the corresponding columns in last year's Report, due to the criterion for inclusion. For example, a department that did not respond to this year's Survey is not included this year although it may have been included in the tally for last year.

TABLE 4: Number of New Mathematics and Statistics Doctorates Reported by Selected Departments

	83-84	84-85	85-86
Group I (37 of 39 depts.)	220	269	256
Group II (37 of 43 depts.)	117	74	112
Group III (47 of 73 depts.)	83	61	71
Subtotal	420	404	439
Group IV (44 of 69 depts.)	139	150	137
Group Va (9 of 17 depts.)	25	32	21
Group Vb (13 of 38 depts.)	71	49	55
Group VI (25 of 28 depts.)	47	39	43
Total	702	674	695

Citizenship and Sex of U.S. Doctorates, 1972–1986. Again this year, information is presented on the annual number of doctorates granted by U.S. universities to U.S. citizens (Table 5). This number is divided into male and female doctorates (Table 6). These data are presented for the period 1972–1986 using the Annual AMS Survey Reports on new doctorates published each year in the October or November *Notices*. Thus Tables 5 and 6 are extensions of tables in last year's Report. In Table 5 the first column (headed Adjusted Total of Doctorates given by U.S. Universities) gives the number of doctorates granted between July 1 and June 30 of the indicated years *whose citizenship is known*. Column 2 gives the number who were U.S. citizens and Column 3 the percentage that this represents. In Table 6 the number in Column 2 of Table 5 is further divided into men and women. Note that in both tables *all years but* 1982-1983, 1983-1984, 1984-1985, and 1985-1986 include doctorates granted by computer science departments.

TABLE 5: U.S. Citizen Doctorates

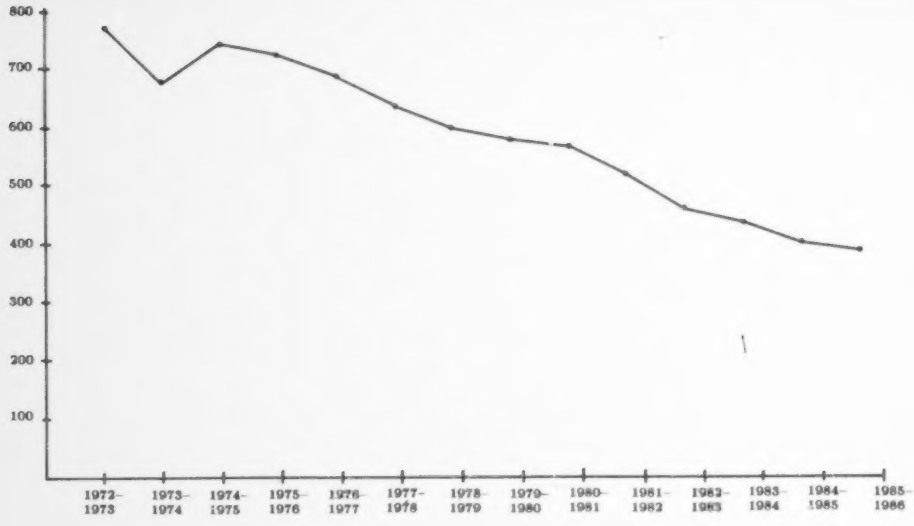
	Adjusted Total of Doctorates given by U.S. universities	Total of Doctorates who are U.S. citizens	%
1972-1973	986	774	78%
1973-1974	938	677	72%
1974-1975	999	741	74%
1975-1976	965	722	75%
1976-1977	901	689	76%
1977-1978	868	634	73%
1978-1979	806	596	74%
1979-1980	791	578	73%
1980-1981	839	567	68%
1981-1982	798	519	65%
1982-1983	744	455	61%
1983-1984	738	433	59%
1984-1985	726	396	55%
1985-1986	755	386	51%

TABLE 6: U.S. Citizen Doctorates, Male and Female

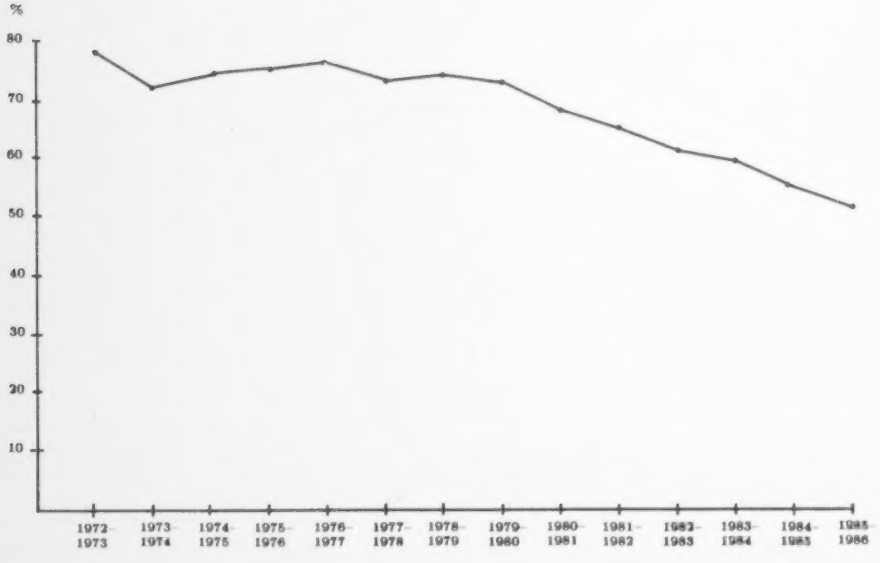
	Doctorates who are U.S. Citizens	Male	Female	% Female
1972-1973	774	696	78	10%
1973-1974	677	618	59	9%
1974-1975	741	658	83	11%
1975-1976	722	636	86	12%
1976-1977	689	602	87	13%
1977-1978	634	545	89	14%
1978-1979	596	503	93	16%
1979-1980	578	491	87	15%
1980-1981	567	465	102	18%
1981-1982	519	431	88	17%
1982-1983	455	366	89	20%
1983-1984	433	346	87	20%
1984-1985	396	315	81	20%
1985-1986	386	304	82	21%

We reiterate our concern at the persistent plummeting in both the absolute number and the relative percentage of U.S. citizens among the new Ph.D.'s in the mathematical sciences. There are several important and timely questions and issues that need to be raised and addressed on this and similar trends in the mathematical and scientific disciplines. For example, how will a moderate to severe shortage of well-trained Ph.D.'s in the mathematical sciences impact on American business, industry, and government? Will American institutions—educational and otherwise—enter the 21st century with a disproportionate part of their population of mathematical scientists at, near, or past retirement age and find an inadequate number of qualified replacements?

Recently, the Conference Board of the Mathematical Sciences (CBMS), a consortium of mathematics organizations including the AMS, appointed a "Committee on American Graduate Mathematics Enrollments," chaired by Professor Barry Simon of the California Institute of Technology, to address these concerns. (See *Notices*, August 1986, page 626, for the complete charge to the committee.) The Committee has solicited comments from the members of the mathematical community. They may be addressed to: Professor Barry Simon, CBMS Committee on American Graduate Mathematics Enrollment, Mathematics Department, 253-37, California Institute of Technology, Pasadena, CA 91125. To be most useful to the Committee, your comments should arrive before December 1, 1986.



Graph for Table 5: U.S. Citizen Doctorates
Total of Doctorates who are U.S. Citizens



Graph for Table 5: U.S. Citizen Doctorates
Total of Doctorates by Percent

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Notices
of the American Mathematical Society

30th Annual AMS Survey 1986

Second Report

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Second Report

A first report of the 1986 Survey appeared in the November 1986 *Notices*, pages 910–938. It included a report of the survey of faculty salaries, tenure, and women, a first report of the survey of new 1985–1986 doctorates, and a list of the names and thesis titles of the 1985–1986 doctorates included in the Survey. This second report includes an update of the fall 1986 employment status of new doctorates, an analysis of faculty mobility, and a report on fall 1986 enrollments and class sizes.

The 30th Annual AMS Survey was made under the direction of the Society's Committee on Employment and Educational Policy (CEEP), whose members in 1986 were Stefan A. Burr, Edward A. Connors, Philip C. Curtis, Jr., Gerald J. Janusz, and Donald C. Rung (chairman). A Data Subcommittee of CEEP, consisting of Lida K. Barrett, Edward A. Connors (chairman), Lincoln K. Durst, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung, designed the questionnaires with which the data were collected. The committee is grateful to members of the AMS staff, especially Marcia C. Almeida, for the diligence and efficiency with which the data were collected and compiled. Comments or suggestions regarding this program may be directed to the subcommittee.

Employment of New Mathematical Science Doctorates Faculty Mobility, Employment Trends, Enrollments and Departmental Size, Fall 1986

by Edward A. Connors

I. Introduction and Overview

We present patterns of employment for new doctorates in the mathematical sciences (commencing with an update of the employment status of the 1985–1986 class) and we analyze trends in the academic job market based on the 1986 AMS Survey of Faculty Mobility (30th Annual). We also provide estimates for course enrollments, majors, graduate students, and faculty in the mathematical sciences as extrapolated from the data gathered from returns of the 1986 AMS Survey on Enrollments and Departmental Size. Our extrapolation methodology is described below in the section headed "A Comment on our Extrapolation Methodology." The Mobility and Enrollments Surveys requested data for fall 1985 and fall 1986, so we have data for consecutive years from the same population. We attempt to survey all four-year college and university departments in the mathematical sciences (see below for the response rates in the various groupings). The Mobility section of the survey has three parts (Size of Faculty, Faculty Entering Department, and Faculty Leaving Department) and we use the data reported only if all three responses are useable. However, the Enrollments and Departmental Size survey form has four parts (Course Enrollments, Majors, Departmental Size, and Graduate Students) and we treat each of the parts as a separate entity as to its useability. Note that useable responses to the Mobility Survey came from 75% of Groups I–III combined, 64% of Group IV, 49% of Group M, and 37% of Group B.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0 – 5.0 range.

Group II is composed of 43 departments with scores in the 2.0 – 2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257 – 267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392 – 393.

We regard as significant the relative increase of new women doctorates hired by the doctorate-granting institutions in Groups I-III. More specifically, 18% of all hires of new doctorates in Groups I-III were from the class of new women doctorates—this compares to 13% last year and, approximately, 10% for each of the three previous years. In fact, among all U.S. doctorate-granting institutions in the mathematical sciences (Groups I–V) new women doctorates represent 19% (40/208) of all new doctorates hired. Women doctorates comprise 17% of the new doctorates (140/801).

Useable Responses

	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	29	34	62	48	9	19	148	350
Faculty Mobility	29	33	54	44	9	14	129	361

*There are 4 parts to the Enrollments and Departmental Size Form (Enrollments, Majors, Departmental Size, and Graduate Students). The number given is the number of returns with a useable response on the departmental size.

Useable Responses (Percentage of Population)

	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	74	79	85	70	15	66	56	36
Faculty Mobility	74	77	74	64	15	48	49	37

*As Above.

New Doctorates
Fall and Spring Counts

	1982-1983	1983-1984	1984-1985	1985-1986
Fall	792	789	769	801
Spring	840	827	807	827

New Doctorates
U.S. Institutions Spring Count

1982-1983	1983-1984	1984-1985	1985-1986
796	775	765	782

New Doctorates
Awarded by Groups I–Va, VI Spring Count

1982-1983	1983-1984	1984-1985	1985-1986
767	735	755	743

Table 1A: 1985-1986 Employment Status of New Doctorates in the Mathematical Sciences

	PURE MATHEMATICS											
Type of Employer	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	19	20	23	1	1	3	2	0	16	0	4	89
Group II	5	4	8	0	2	1	0	0	11	0	3	34
Group III	4	9	8	3	1	7	1	1	10	1	2	47
Group IV	0	0	0	0	4	29	0	0	0	0	3	36
Group V	0	2	0	0	1	4	1	4	6	0	1	19
Masters	10	8	9	3	0	10	2	2	14	0	4	62
Bachelors	11	16	8	8	3	5	2	2	9	0	2	66
Two-year College or High School	1	1	0	0	0	0	0	1	0	1	1	5
Other Academic Departments	1	3	1	1	2	19	2	15	12	0	11	67
Research Institutes	4	3	0	0	0	5	0	1	2	0	1	16
Government	1	0	2	1	0	9	0	3	6	0	5	27
Business and Industry	4	7	1	1	2	32	4	15	22	0	21	109
Canada, Academic	4	5	2	1	0	4	0	1	6	0	1	24
Canada, Nonacademic	1	0	1	0	0	1	0	0	2	0	0	5
Foreign, Academic	17	20	6	2	3	19	0	4	14	0	6	91
Foreign, Nonacademic	6	6	3	2	5	14	2	11	9	0	7	65
Not seeking employ.	1	1	1	0	0	5	0	0	1	0	0	9
Not yet employed	5	0	2	0	1	3	0	1	5	0	0	17
Unknown	3	2	1	0	1	1	0	1	4	0	0	13
Total	97	107	76	23	26	171	16	62	149	2	72	801

For the first time our survey asked for data on citizenship of graduate students. We requested data for fall 1985 and fall 1986 on citizenship of all graduate students and first-year graduate students, with answer options given as U.S., Canada, other, and unknown. In Groups I–III combined, U.S. citizens comprise 53% of all graduate students, and of first-year graduate students, whose citizenship was reported as known for fall 1986 (see Table 8). The raw data show an increase of U.S. citizens from fall 1985 to fall 1986 in both the first-year and total graduate student populations.

For the second consecutive year we report a decrease in total enrollments in courses taught by mathematical science departments, with a good share of the decrease resulting from a drastic decline in computer science courses. Graduate student numbers are up both for first-year and all graduate students across the board, but the number of junior-senior majors is down (see Tables 5, 6, and 7). The decline in computer science enrollments (within mathematical science departments) can be explained, we feel, by the continued creation of separate computer science departments, and the continued decline in interest in computer science careers and concentrations among entering freshmen. For example, the Higher Education Research Institute's survey of over 200,000 freshmen at 372 institutions reports that 3.5% of all surveyed reported an interest in pursuing computer careers as compared to 8.8% who so reported in 1982 (*Chronicle of Higher Education*, January 14, 1987, vol. XXXIII, no. 18, page 38).

Summing over columns of the updated employment matrix shows that of the 801 new doctorates (fall count), 171 (21%) specialized in statistics, 149 (19%) specialized in applied mathematics, 62 (8%) specialized in operations research, and 16 (2%) specialized in computer science. All told, 398 (50%) of the new doctorates are in statistics, applied mathematics, operations research, or computer science. (See Table 1B for the comparable data for the last four surveys.)

Government employment of new doctorates is nearly double that reported last year (27 compared to 14), while the total number employed by business or industry is virtually identical (109 to 108).

Part-time faculty continue their significant role in undergraduate instruction in departments in Groups M and B at roughly the same level of participation as last year. Here we have an estimated 5,270 part-time faculty (909 doctorate holding, 4,361 nondoctorate holding). In contrast, 966 part-time faculty are utilized by Groups I, II, and III combined, and approximately half of these are in Group III. If we examine the total faculty staff reported, we find that Groups B and M both report 29% part-time faculty. In contrast, Group I reports 9%, Group II reports 13%, and Group III reports 21%. We alert the reader to a forthcoming report of the MAA Committee on Teaching Assistants and Part-Time Instructors, chaired by Professor Bettye Anne Case of Florida State University, and to the CBMS 1985 Survey, chaired by Professor R. D. Anderson of Louisiana State University.

Estimates based on AMS Survey data suggest a shortfall in the number of doctorates needed for academic positions in the mathematical sciences. This shortage is most felt by the Group M and B institutions where we estimate that, of 560 new positions filled by nondoctorates, the departments would have preferred to fill 337 with doctorate-holding faculty. Of the 609 new positions filled by nondoctorate faculty in all U.S. colleges and universities (excluding Group V), the department would have preferred to fill 357 with doctorate-holding faculty.

We estimate the full-time faculty in Groups M and B combined to be 13,324 (an increase of 272 from fall 1985). Groups I–IV combined contain, we estimate, 6,719 full-time faculty (an increase of 93 over fall 1985). Tables 1A–1C provide the doctorate-nondoctorate breakdown. Thus, exclusive of Group V, we estimate the total U.S. mathematical sciences faculty to be approximately 20,000, of which approximately 15,600 hold doctorates.

Continuing the policy enunciated in the first report of the 1983 Survey, the survey no longer contains data from departments of computer science. The limited response from these departments made reliable estimates difficult. For the third year, returns from Group V departments were too small to be included. This survey, then, is an analysis of what might be called the traditional mathematics and statistics community. Because the response rate in the remaining groups continues at a high level, this year's survey gives a fairly accurate picture of faculty mobil-

Table 1B: Fields of New Doctorates*

	Year surveyed			
	1982–1983	1983–1984	1984–1985	1985–1986
Number (Full Count)	792	789	769	801
Specialty:				
Applied Math	103 (13%)	110 (14%)	115 (15%)	149 (19%)
Statistics	188 (24%)	173 (22%)	189 (25%)	171 (21%)
Operations Research	63 (8%)	66 (8%)	41 (5%)	62 (8%)
Computer Science	18 (2%)	20 (3%)	15 (2%)	16 (2%)
Total	372 (47%)	369 (47%)	360 (47%)	398 (50%)

ity, enrollments, etc., within this community. It should be noted that while departments of computer science are not included in the survey, many departments of mathematics in Groups M and B teach computer science.

II. A Comment on Our Extrapolation Methodology

The numbers in Tables 2–8 were obtained by extrapolation from the AMS Surveys and are not actual counts. The various reported totals for each group were multiplied by the ratio of the size of the faculty in that group (obtained by adjusting the comparable number given in the 1980 CBMS Report) to the number of faculty members in the responding departments, as provided on the forms submitted. We illustrate with some examples of computations and estimates from this year's survey.

We begin with our estimate of the number of full-time faculty in Groups I, II, and III combined. This number was estimated to be 5,845 in fall 1985, based on the 1980 CBMS number and adjusting yearly with AMS Survey data as follows. We received useable answers to the Faculty Mobility Survey from Groups I, II, and III, reporting 4,307 full-time faculty for fall 1985. The ratio of 5,845 to 4,307, or 1.36, is our extrapolation index for Groups I, II, and III on the mobility issues of this report. For example, they reported 131 new doctorate faculty as coming directly from graduate school, so we extrapolate to 178 (as reported

Table 2A: Faculty Flow 1985-1986 To 1986-1987

Full-Time Doctorate-Holding Faculty in 155 Doctorate-Granting Mathematics Departments in the U.S. (Groups I, II, III)

Sources of New Faculty

From	Nontenured	Tenured
Graduate school	178	
Faculty position in another U.S. or Canadian college or univ. dept.	140	39
Business, industry, or government in the U.S. or Canada	4	
Outside the U.S. or Canada	52	5
Other sources (e g., part-time in same dept.)	7	8
Total in	381	52

Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	110	33
Other four-year college or university position	48	15
Two year college	4	
Other	15	7
Total Academic	177	55

Faculty Leaving (continued)

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	30	7
Other	3	4
Total Nonacademic	33	11
To OTHER:		
Currently seeking professional employment	7	
Obtained a position outside the U.S or Canada	16	3
Either retired (and do not seek employment) or have died	4	52
Returned to graduate or professional school	3	
Status unknown/other	5	3
Total Other	35	58
Total out	245	124

Received doctorate and not moving	12 (tenure status unknown)
Received tenure and not moving	110

Estimated size of full-time faculty, Fall 1986 Groups I–III

Doctorate, Tenure status unknown	12	
Doctorate, Nontenured	1281	(+26 from Fall 1985)
Doctorate, Tenured	4242	(+38 from Fall 1985)
Total Doctorate Faculty	5533	(+76 from Fall 1985)
Nondoctorate faculty	396	(+10 from Fall 1985)
Total full-time faculty	5931	(+86 from Fall 1985)

in Table 2A, Faculty Flow for Groups I, II, III). As a check we observe that the updated employment matrix (Table 1A) reports that 170 of the new doctorates were employed by Groups I, II, and III. However, our knowledge of a few institutions that did not respond to the new doctorate survey leads us to suspect that the employment matrix total would almost exactly match the extrapolated total if responses were complete.

Useable responses on the departmental size portion of the Enrollments and Departmental Size Survey report 4,695 full-time faculty in Groups I, II, and III, and hence an index of 5,845/4,695, or 1.24. However, there were 125 useable responses to the enrollments portion. Thus, we extrapolate the reported enrollment data for Groups I, II, III by multiplying the raw data reported by the product of 1.24 and 125/121. Similarly, for the majors portion of the survey (119 useable responses) and for the graduate students portion (97 useable responses).

III. Comments and Observations on the Fall 1986 Employment Status of 1985–1986 New Doctorates

Table 1A contains the fall 1986 employment status by type of employer and field of degree for 801 new mathematical sciences doctorates who received the degree between July 1, 1985, and June 30, 1986. The names of these 801 new doctorates and the titles of their doctoral theses were published in the November 1986 *Notices*, pages 924 to 938. Table 1A updates the corresponding table on page 920 of the November 1986 *Notices*, using more

Table 2B: Faculty Flow 1985-1986 To 1986-1987

Full-Time Doctorate-Holding Faculty in Group IV

Sources of New Faculty

From	Nontenured	Tenured
Graduate school	22	
Faculty position in another U.S. or Canadian college or univ. dept.	19	7
Business, industry, or government in the U.S. or Canada	5	
Outside the U.S. or Canada	2	2
Other sources (e.g., part-time in same dept.)	1	
Total in	49	9

Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	14	3
Other four-year college or university position	6	
Two year college		
Other	1	
Total Academic	21	3

Faculty Leaving (continued)

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	7	2
Other	1	
Total Nonacademic	8	2
To OTHER:		
Currently seeking professional employment	1	
Obtained a position outside the U.S or Canada	6	
Either retired (and do not seek employment) or have died	0	9
Returned to graduate or professional school	0	
Status unknown/other	0	
Total Other	7	9
Total out	36	14

Received doctorate and not moving	1
Received tenure and not moving	20

Estimated size of full-time faculty, Fall 1986 Group IV

Doctorate, Tenure status unknown	1	
Doctorate, Nontenured	240	(– 7 from Fall 1985)
Doctorate, Tenured	528	(+15 from Fall 1985)
Total Doctorate Faculty	769	
Nondoctorate faculty	19	(– 2 from Fall 1985)
Total full-time faculty	788	(+ 7 from Fall 1985)

recent information provided by departments and the recipients of the degrees. Note that 801 is the fall count for 1985–1986 and does not include the additional recipients who were reported too late to gather employment information for these reports, but who are included in the spring count for 1985–1986. (A supplementary list of recipients appears in this issue of *Notices*.)

The first five rows in Table 1A refer to those 1985–1986 new doctorates employed by doctorate-granting departments in the U.S. The next two rows refer to those employed by U.S. mathematical sciences departments which grant master's and bachelor's degrees as the highest degree, respectively. The remaining row designations are self-explanatory.

Academic Employment

There was an increase over last year in the hiring of new doctorates by U.S. doctorate-granting departments (225 versus 206) with a marked increase in Group IV (36 versus 19). The decline in hiring of new doctorates by Group III (47, down from 59) is tempered by the realization that only 39 were hired two years ago. Note that these comparisons are derived from the updated employment matrices which appear annually in the February or March issue of these *Notices*. Fewer new doctorates were hired by Groups M and B than last year (128 versus 138) but approximately 337 positions that M and B departments intended for doctorate holders were filled by nondoctorate faculty. It seems that job prospects for new

Table 2C: Faculty Flow 1985-1986 To 1986-1987

Full-Time Mathematical Sciences Faculty in Groups M and B

Sources of New Faculty

From	Doctorate	Nondoctorate
Graduate school	151	236
Faculty position in another U.S. or Canadian college or univ. dept.	394	126
Business, industry, or government in the U.S. or Canada	47	57
Outside the U.S. or Canada	35	5
Other sources (e.g., part-time in same dept.)	62	136
Total in	689	560

Faculty Leaving

	Doctorate	Nondoctorate
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	50	12
Other four-year college or university position	173	109
Two year college	7	15
Other	17	62
Total Academic	247	198

Faculty Leaving (continued)

	Doctorate	Nondoctorate
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	47	69
Other	10	10
Total Nonacademic	57	79
To OTHER:		
Currently seeking professional employment	17	30
Obtained a position outside the U.S or Canada	10	7
Either retired (and do not seek employment) or have died	67	102
Returned to graduate or professional school	7	69
Status unknown/other	32	55
Total Other	133	263
Total out	437	540

Received doctorate and not moving	99
Received tenure and not moving	
Doctorate	270
Nondoctorate	47

Estimated size of full-time faculty, Fall 1986 Groups M and B

Doctorate holding	9295	(+351 from Fall 1985)
Nondoctorate faculty	4029	(− 79 from Fall 1985)
Total full-time faculty*	13324	(+272 from Fall 1985)

* Last year's total of 13,052 is reported correctly in the table, but it is misprinted as 13,502 in the text on p. 293.

doctorates in the mathematical sciences are very good in Groups M and B, especially if academic and teaching strengths are complemented by an ability to teach statistics and computer science.

As reported earlier, new women doctorates comprise 18% of the new doctorates employed by Groups I–III (compared to only 13% last year and 10% each of the three previous years). Among all U. S. doctorate-granting institutions (departments or programs) 19% of new mathematical science doctorates were women. Although the percentage of women among all new doctorates is 17%, we caution that the apparent gain is relative only—only 140 of 801 new doctorates were awarded to women. In Groups I–IV, M, and B, the percentage of new women doctoratees to all new doctorates hired is: Group I (13%), Group II (26%), Group III (21%), Group IV (25%), Group M (19%), and Group B (21%).

The number of new doctorates accepting Canadian academic positions increased slightly over last year (24 versus 22), whereas the number accepting foreign, non-Canadian academic positions decreased (91 from 96).

Faculty Mobility

This part of the Annual Survey is concerned with the numbers and sources of newly hired faculty and the employment status of the recently departed. We monitor trends in tenure and doctorate recipients. The response to the 1986 Faculty Mobility Survey was considerably larger than last year and larger than two years ago. The responding departments account for more than half (52%) of all mathematical sciences faculty members. Roughly 75% of the faculty in the doctorate-granting mathematics departments (Groups I–III) are represented in the responses. The relevant tables are 2A, 2B, and 2C.

Tables 2A, 2B, and 2C show estimated faculty flow between 1985–1986 and 1986–1987 for U. S. departments. A composite number for all U. S. departments, excluding Group V, may be obtained by adding corresponding rows. The left side of each table shows the estimated numbers of new full-time faculty members hired from the sources indicated between fall 1985 and fall 1986. The right side of each table shows the fall 1986 employment status of those full-time faculty members (as of fall 1985) who had permanently left their departments by fall 1986.

Combining Tables 2A, 2B, and 2C, we show an estimated increase of 423 in the size of the doctorate-holding faculty and a decrease of 71 in the nondoctorate faculty, for an overall increase of 352. Last year's net increase was 469 and the previous year's was 681. We estimate that of 606 positions filled by nondoctorates in Groups III, M, and B, doctorate-holding faculty were preferred for 355. Thus we have a pattern of replacement and/or utilization of nondoctorate faculty in lieu of doctorate-holding faculty among the vast majority of our mathematical sciences departments.

Attrition because of death and retirement was 1.2%, down from last year's 1.4% but equal to the previous year. Retirements and deaths seem to hover near 1%.

Nonacademic Employment

Table 3 presents a summary of AMS Survey data on nonacademic employment in the U. S. of new doctorates from 1979–1980 to 1985–1986. Note that the percentage of new doctorates in government/business/industry had held constant at 22% (of all new doctorates) for three years, but jumped to 24% on the strength of increased government hiring. This year 27 new doctorates

Table 3: New Mathematical Sciences Doctorates Taking Nonacademic Positions in U.S.

	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84	1984 -85	1985 -86
In government	37	28	22	24	23	14	27
In business/ industry	165	169	141	105	110	108	109
Total	202	197	163	129	133	122	136
Total new doctorates employed in U.S.	691	732	659	583	597	557	577
% in govt./ bus./ind.	29%	27%	25%	22%	22%	22%	24%

Table 4: Estimated Net Outflow of Doctorate-Holding Faculty Members to Nonacademic Employment

	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84	1984 -85	1985 -86
Net outflow	168	116	94	46	125	22	55

took employment with government compared to 14 last year.

Table 4 presents the estimated annual net outflow of doctorate-holding faculty to nonacademic positions since 1979. The number 55 is obtained from Tables 2A, 2B, and 2C, with the breakdown as follows. Groups I, II, III combined (net outflow of 40); Group IV (net outflow of 5); Groups M and B (net outflow of 10). The net outflow is much more than twice that of a year ago but less than half of two years ago.

Enrollments

Undergraduate enrollments declined for the second straight year but a considerable portion of the decline is tied to the shift in computer science courses taught in mathematics departments. Several of the computer science courses previously taught in mathematics departments are now being taught in rather recently created computer science departments. At the same time, there is a precipitous decline in interest in computer science as a major, especially among freshmen (see the *Chronicle* article cited earlier). There is an increase in graduate enrollments and another increase in "courses below calculus" (excluding computer science and statistics). The increase in these so-called "precalculus" and, often, remedial courses is most felt in Group B (+3%). It does seem, however, that the hitherto rapid rate of increase of precalculus and remedial courses has lessened somewhat.

IV. Summary

In summary, we report an increase over last year in the number of new doctorates in the mathematical sciences—the first such increase in several years. The percentage and absolute number of U.S. citizens among the doctoral recipients from U.S. institutions continued to decline (see the First Report of the 30th Annual AMS Survey in the November 1986 *Notices*, pages 922–923). The percentage of women among the new doctorates (including Canadian degrees) is 17% (fall count—used for consistency in comparison utilizing updated employed matrix, Table 1A). The percentage of women among the new doctorates hired by U.S. doctorate-granting institutions is 19%. The percentage of women among the new doctorates hired by Groups M and B is 20%. A significant percentage (60%) of nondoctorate faculty were hired in Groups M and B for positions for which the department indicated a preference for a doctorate holder. We project that 337 positions were so filled. In U.S. doctorate-granting departments U.S. citizens account for approximately 53% of the graduate students whose citizenship is reported as known. In Groups I, II, and III, the number of U.S. citizens among first-year graduate students is up by 6% over last year (reporting institutions are the same for fall 1985 and fall 1986) Fifty percent of the new doctorates are in the fields of statistics (21%), applied mathematics (19%), operations research (8%), or computer science (2%). We note that the percentages and the absolute numbers in applied mathematics itself are substantially up from our surveys in the early 1980s. Overall course enrollments are down slightly, but a good part of the decline is because of decreased teaching of computer science courses in mathematics departments. In Groups M and B enrollments in remedial and/or "precalculus" courses increased over fall 1985 but the rate of increase is not as great as it has been in recent years. Graduate enrollments are up in all groups and undergraduate enrollments in statistics rose by 2% in Group M.

Table 5: Total Course Enrollments for Fall 1986 (in Thousands)

(Percent increase from fall 1985 in parentheses)*

Type of Course	Groups							
	I, II, III		IV		VI		M, B	
Below calculus	285	(0%)			10	(+1%)	637	(+2%)
First year calculus	214	(−4%)			43	(+3%)	232	(−4%)
Statistics	26	(−2%)	52	(−3%)	28	(+8%)	109	(+1%)
Computer Science	13	(−27%)			4	(−10%)	174	(−11%)
Other undergraduate mathematics courses	172	(−3%)			45	(−4%)	203	(−3%)
Total Undergraduate	710	(−3%)			130	(+1%)	1355	(−2%)
Graduate courses	27	(+1%)	14	(+11%)	1	(+29%)	21	(+9%)
All courses	737	(−3%)	66	(0%)	131	(+1%)	1376	(−3%)

*This percentage is obtained from the raw data as reported for the two years on this 30th Annual Survey. It is not based on last year's estimates.

Table 6: Majors

(Percent increase over fall 1985 in parentheses)*

Fall 1986

	I, II, III	IV	VI	M, B
Total junior-senior majors	19215 (−2%)	1060 (+13%)	5660 (+7%)	62797 (−2%)

*See footnote for Table 5.

Table 7: Graduate Students

(Percent increase over fall 1985 in parentheses)

Fall 1986

	I, II, III	IV	VI	M + B
First Year	2959 (+6%)	653 (+12%)	246 (+1%)	1261 (+9%)
All	9013 (+6%)	1925 (+5%)	700 (+16%)	3265 (+1%)

Table 8: Citizenship of Graduate Students

(Percentage of U.S. citizens of graduate students whose citizenship is reported as known)

	Fall 1985		Fall 1986	
Group	First Year	All Years	First Year	All Years
I	55	54	54	54
II	53	55	54	53
III	52	54	52	51
I,II,III	53	54	53	53
IV	56	53	59	53
M	72	63	66	69

Table 9: Average Class Size Fall 1986

(Fall 1985 size as also reported in this year's survey is in parentheses)

	Groups											
Type of Course	I		II		III		IV		M		B	
Below calculus (excluding statistics and computer science)	35	(36)	41	(42)	49	(47)	—	—	38	(38)	30	(30)
First year calculus	36	(37)	44	(44)	41	(41)	—	—	32	(33)	26	(26)
Undergraduate statistics	30	(31)	27	(27)	37	(39)	42	(43)	33	(34)	27	(27)
Undergraduate computer science	32	(36)	27	(27)	28	(31)	—	—	24	(25)	20	(21)
Other Undergraduate mathematics	30	(31)	32	(33)	32	(32)	—	—	24	(25)	17	(17)
All graduate	10	(10)	11	(11)	10	(10)	16	(15)	10	(11)		
Total	30	(32)	36	(36)	37	(37)	32	(32)	30	(31)	24	(25)

Doctoral Degrees Conferred in 1985–1986 (Supplementary List)

The following list supplements the list of thesis titles published in the November 1986 issue of *Notices* (see page 924 for an explanation of the numbers in parentheses).

ARIZONA

University of Arizona
(8;2,0,0,0,6,0,0)

APPLIED MATHEMATICS

Clough, Anne, *A mathematical model of single photon emission computed tomography.*

Dagan, Arie, *Some aspects of vortex line reconnection.*

Hammel, Steven, *A dissipative map of the plane—a model for optical bistability.*

Shelley, Michael, *The application of boundary integral techniques to multiply connected domains.*

Tonellato, Peter, *Critical behavior of an ignition model in chemical combustion.*

Weyker, Robert, *Resonance and asymptotic series based identification of an acoustically rigid sphere.*

MATHEMATICS

Sade, Martin, *Variational principles for field variables subject to group actions.*

Wang, Kwang-Shang, *Finite groups for which every complex representation is realizable.*

ILLINOIS

University of Chicago
(3;2,0,0,0,1,0,0)

MATHEMATICS

Crane, Louis, *Action of the loop group on the self-dual Yang-Mills equation.*

Harris, John, *Stable splittings of classifying spaces.*

Squeff, Christina, *Super-convergence of mixed finite element methods for parabolic equations.*

NEW YORK

CUNY, Graduate Center
(2;1,0,0,0,1,0,0)

MATHEMATICS

Benardete, Diego, *Topological equivalence of flows on homogeneous spaces, divergence of subgroups, and asymptotic homotopy classes.*

Kim, Myong-Hi, *Complexity of Newton-Euler type algorithms.*

PENNSYLVANIA

Carnegie-Mellon University
(4;1,0,0,0,2,0,1)

MATHEMATICS

Chang, Ching Lung, *Finite element approximations for first order linear elliptic systems.*

Hodgdon, Marion Louise, *Solutions of the Field relations in a theory of shear bands.*

Strojwas, Malina, *Tangential approximations.*

Turner, James Clarence, *A finite element analysis of a zero equation model of turbulence.*

Lehigh University
(2;1,0,0,0,0,0,1)

MATHEMATICS

Bailey, Carmine Michael, *On the optimum design of piston rings.*

Schaffer, Matthew John, *Permanence and universal family theorems for conuli FK spaces.*

SOUTH CAROLINA

Clemson University
(7;1,1,1,0,1,0,3)

MATHEMATICAL SCIENCES

Chien, Victor, *Parameter estimation for a diffusion problem in a semi-infinite interval.*

Kovalcik, William, *A lumped parameter model of evaporation-condensation driven convective flows in atmospheric environments.*

Padua, Roberto, *Some robust estimates of the regression coefficients.*

Peters, Kenneth, *Theoretical and algorithmic results on domination and connectivity.*

Piazza, Barry, *Hamiltonian and connectivity properties of permutation graphs.*

Portier, Frederick J., *An integrated approach to discrete simulation: Theory, methodology, and computer aided program generation.*

Stueckle, Samuel, *Algebraic and isomorphism properties of permutation graphs.*